

MAGELLAN MISSION PROGRESS REPORT: Thomas W. Thompson and **Magellan**
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The **Magellan** spacecraft was launched from Cape Kennedy on May 4, 1989 and was inserted into orbit around Venus on August 10, 1990. The **Magellan** science objectives are (1) improve the knowledge of the geologic history of Venus by analysis of surface morphology and (2) improve the knowledge of the geophysics of Venus, principally its density distribution and dynamics. The first objective was supported by radar imaging, **altimetric** and radiometric mapping of the Venusian surface which commenced on September 15, 1990 and continued until September 15, 1992 (mission cycles 1,2,3). Some 98 percent of the surface has been mapped with radar resolutions on the order of 120 meters. The second objective is still being pursued. High resolution Doppler tracking of the spacecraft in elliptical orbit from September 16, 1992 until May 24, 1993 (mission cycle 4) provided gravity observations of Venusian near-equatorial regions. The **Magellan** orbit was circularized in the summer of 1993. Now, high resolution Doppler tracking of the spacecraft in near-circular orbit (which commenced in August 1993) is providing gravity measurements of all of Venus.

The two years of radar and radiometric observations of Venus constitute three mission cycles. The first mission cycle from mid-September 1990 through mid-May 1993 emphasized the acquisition of radar images from the left side of the orbit, from over the North pole to as far south as possible. Some 84 percent of the surface was mapped in this first mission cycle. The second mission cycle from mid-May 1991 through mid-January 1992 acquired radar images from the right side of the orbit with the goal of mapping the south polar regions of Venus. The third mission cycle from mid-January through mid-September returned to left-side imaging with the goal of stereo imaging. Unfortunately, a transponder failure early in January 1992 curtailed data acquisition throughout the third mission cycle. However, some 24 percent of the surface was observed in this third mission cycle and 98 percent of the Venusian surface was imaged in total.

The processing of the radar data by JPL was completed in late 1993. Over 1200 radar image products are available as analog photographs and digital compact disks (CD-ROMs) at the National Space Science Data Center (NSSDC), Goddard Space Flight Center, Greenbelt, Maryland. In addition, the **altimetric** and radiometric data products from MIT and the cartographic maps from USGS are available at the NSSDC. The altimeter and radiometer data produced by Peter Ford and Gordon Pettengill at MIT are available as images as well as digital data on 17 CD-ROMs. Also, the United States Geological Survey (USGS) in Flagstaff, Arizona is producing a second generation of radar mosaics that should be available soon. A useful contact for these **Magellan** data products is the Planetary Data System (PDS) Geosciences Node at Washington University, St. Louis, Missouri.

The first set of high-resolution gravity observations were obtained between late-September 1992 and late May 1993. Some 950 orbits were obtained while **Magellan** was in an elliptical orbit with a periapsis near 175 kilometers and an apoapsis near 8,000 kilometers. These data were reduced to a 60 degree-by 60-degree harmonic field by Bill Sjogren of JPL. **Magellan** gravity products, line-of-sight acceleration profiles and spherical harmonic fields for this cycle-4 gravity data are at NSSDC also.

The **Magellan** spacecraft was **aerobraked** from late May through early August 1993 by lowering periapsis to about 140 kilometers. During aerobraking the atmospheric drag at periapsis removed a small amount of orbital energy on each pass. The apoapsis was lowered from 8,000 kilometers to 500 kilometers. **Magellan** now orbits Venus with a near-circular orbit which passes over the polar regions with altitudes of a few hundred kilometers. High resolution Doppler tracking of the spacecraft now provides gravity measurements with near **uniform** resolutions.

Magellan has also provided information about the **Venusian** atmosphere. The high effective isotropic radiated power of the **Magellan** downlink radio system enabled the deepest probing of the Venusian atmosphere by occultation. Refractivity and absorptivity profiles down to 35 km at 3.8 cm wavelength and down to 34 km at 13 cm wavelength have been obtained near 65-deg North with a solar zenith angle of 108-deg. This in turn yielded vertical profiles of temperature, pressure and density as well as H₂S04 abundances.

Atmospheric drag measurements, particularly during **aerobraking**, have extended those originally obtained with the Pioneer-Venus spacecraft and have validated the Venus International Reference Atmosphere (VIRA) model. **Magellan** cycle-4 observations at 180 km **perapsis** detected a 4-day oscillation in the day-side thermosphere while nightside observations during **aerobraking** and into mission cycle-5 showed a 5-day oscillation. The new **Magellan** observations at low solar minimum complement the Pioneer-Venus drag observations during high solar activity. Drag torques during **Magellan** near-circular orbit will enable extension of these type of atmospheric observations to a larger range of latitudes and will provide these measurements at a relative rapid rate of once every 95 minutes.

Also the high effective power of the **Magellan** downlink system enables a number of radio and radar experiments, Scintillations in the solar atmosphere close to the Sun are observed during Venus superior conjunctions when the spacecraft passes near the solar disk. Also, bistatic radar observations are being performed by directing the downlink signals toward the surface and observing the echoes with Deep Space Network (DSN) antennas. These "extra" radio and radar experiments as well as the atmospheric drag and occultation observations demonstrate that **Magellan** is producing useful scientific data beyond that originally specified in the mission objectives.

MAGELLAN MISSION TIMELINE

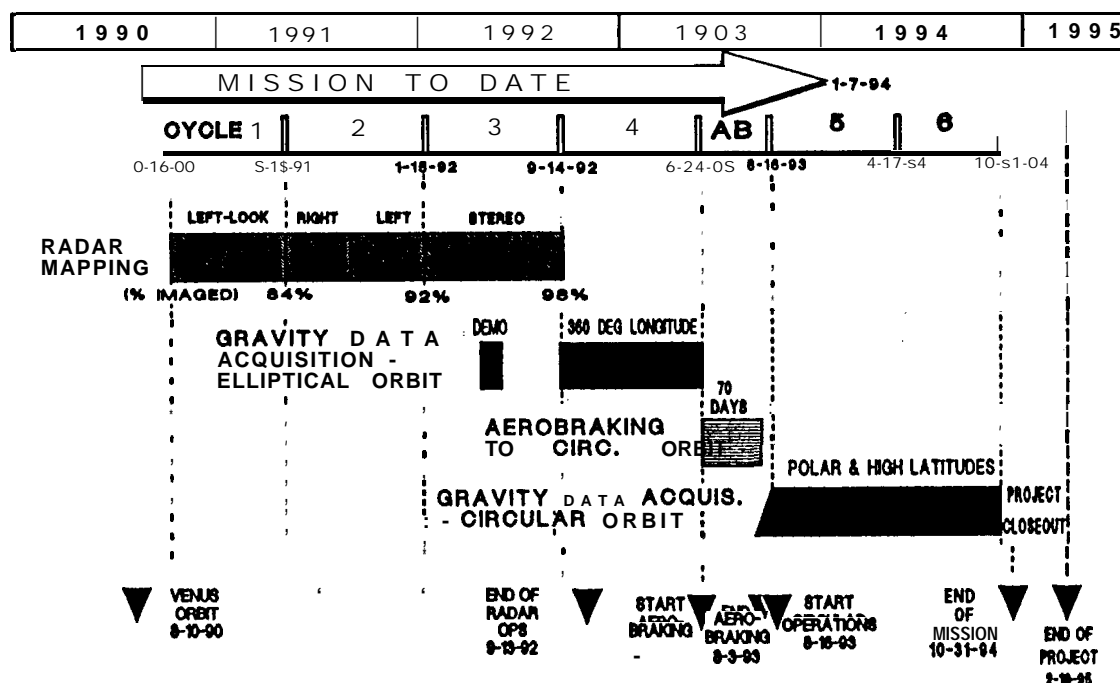


Figure 1 Magellan Mission Timeline